

MEA Switch User Manual



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1 Introduction

1.1 About this Manual

This manual comprises all important information about the first installation and the proper usage of the MEA Switch. It is assumed that you have a basic understanding of technical terms, but no special skills are required to read this manual.

Make sure you read the "Important Information and Instructions" prior to install or to operate the MEA Switch.

1.2 Scope of Delivery

- 1 MEAS2/1 or MEAS4/2 main device
- 1 Serial (null-modem) cable
- 1 CD with MEA_Switch program
- 1 User Manual

2 Important Information and Instructions

2.1 Operator's Obligations

The operator is obliged to allow only persons to work on the device, who

- are familiar with the safety at work and accident prevention regulations and have been instructed how to use the device;
- are professionally qualified or have specialist knowledge and training and have received instruction in the use of the device;
- have read and understood the chapter on safety and the warning instructions in this manual and confirmed this with their signature.

It must be monitored at regular intervals that the operating personnel are working safely.

Personnel still undergoing training may only work on the device under the supervision of an experienced person.

2.2 Guarantee and Liability

The *General conditions of sale and delivery* of Multi Channel System MCS GmbH always apply. The operator will receive these no later than on conclusion of the contract.

Guarantee and liability claims in the event of injury or material damage are excluded when they are the result of one of the following.

- Improper use of the device
- Improper installation, commissioning, operation or maintenance of the device
- Operating the device when the safety and protective devices are defective and/or inoperable
- Non-observance of the instructions in the manual with regard to transport, storage, installation, commissioning, operation or maintenance of the device
- Unauthorized structural alterations to the device
- Unauthorized modifications to the system settings
- Inadequate monitoring of device components subject to wear
- Improperly executed and unauthorized repairs
- Unauthorized opening of the device or its components
- Catastrophic events due to the effect of foreign bodies or Acts of God

2.3 Important Safety Advice



Warning: Make sure to read the following advice prior to installations of the device. If you do not fulfill all requirements stated below, this may lead to malfunctions, breakage, or even fatal injuries. Obey always the rules of local regulations and laws. Only qualified personnel should be allowed to perform laboratory work. Work according to good laboratory practice to obtain best results and to minimize risks.

The product has been built to the state of the art and in accordance with recognized safety engineering rules. The device may only

- be used for its intended purpose;
- be used when in a perfect condition.

Improper use could lead to serious, even fatal injuries to the user or third parties and damage to the device itself or other material damage.

Malfunctions which could impair safety should be rectified immediately.

This device is **no** medical instrument and **must not** be used on humans.

High Voltage

- When connecting an external power supply, do not mismatch the polarity of the power supply. A wrong connection may lead to fatal damage of the device.
- Use the lowest possible input supply voltage. Do not exceed the maximum input supply voltage of 12 V. The higher the input supply voltage, the more heat is produced by the device.
- Electrical cords must be properly laid and installed. The length and quality of the cords must be in accordance with local provisions.
- Only qualified technicians may work on the electrical system. It is essential that the accident prevention regulations and those of the employers' liability associations are observed.
- Each time before starting up, make sure that the mains supply agrees with the specifications of the product.
- Check the power cord for damage, each time the site is changed. Damaged power cords should be replaced immediately and may never be reused.
- Check the leads for damage. Damaged leads should be replaced immediately and may never be reused.
- Do not try to insert anything sharp or metallic into the case.
- Do not short-circuit the outputs of the device.
- Liquids may cause short circuits or other damage, even could lead to fatal injuries. Keep the device and the power cords always dry. Do not handle it with wet hands. Make sure the device and your experiment are set up in a way that makes it impossible that any liquid spills onto the device or flows into the device from the surface of the table.

Requirements for the installation and during operation

- The device must be set up on a rigid, vibration-free base.
- The device produces heat and can get hot during operation.
- Do not touch the device during operation and do not store flammable materials nearby.
- Do not place anything on top of device, and do not place it on top of another heat producing device.
- Do not open the case of the device.

3 First Use of the MEA Switch

3.1 Welcome to the MEA Switch

The MEA Switch allows you to acquire data from 60 single channels from **two** MEA1060 amplifiers. If you have a 128-channel MC_Card, you can even pick 128 channels in total from two MEA pairs with the MEA Switch for four amplifiers (MEAS4/2). Selected channels are combined to a single Electrode Raw Data stream that is delivered to the MC_Card of the data acquisition computer by a 68-pin MCS High Grade cable. This is useful if you do not need all 60 electrodes on an MEA, because the cell culture or the slice does not cover the whole MEA, but rather single electrodes.

The channel selection is mutually exclusive, that means, if you pick channel 21 on one MEA, you cannot select channel 21 on the other pair. The MEA Switch is software-controlled by the program MEA_Switch via the serial port. You can also use a Terminal or a custom program to control the MEA Switch. Please contact Multi Channel Systems for more information.

The MEA Switch does not replace a Signal Grounding Unit. That means, the channels that are not selected are only removed from the input data stream, but they are not grounded. If you have bad electrodes that produce noise, the noise can still interfere with your input signals.

You need an external power supply for operating the MEA Switch, for example the PS20W.

The following pictures show the rear panel of the MEA Switch (MEAS4/2 with optional BNC connectors) with the output channels, the serial port, and the power supply inputs, and a standard MEA Switch 4/2 connected to four MEA amplifiers.



The MEA_Switch program features two operating modes.

- **Toggle** mode: Toggle each channel button for switching the channels from one amplifier to the other.
- **Select** mode: Pick all active channels from one MEA first, then switch to all 60 channels of the second MEA and select all active channels from this one, and then apply the selection with a single mouse click.

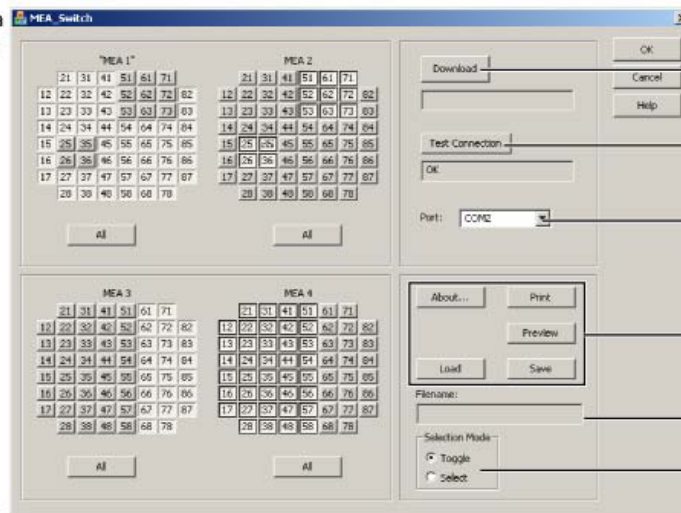
MEA_Switch overview

Each channel of the data stream is either assigned to the left or the right MEA.

You cannot select the same channel on both MEAs.

The buttons represent single channels. Click a button to select or deselect a channel.

With a MEAS4to2 and a 128-channel MC_Card, you can configure the channel layout for two pairs of MEAs separately.



Click **Download** to transfer the channel assignment to the MEA switch.

Click **Test Connection** to test the connection to the MEA switch.

Select the **serial port** to which the MEA switch is connected here.

You can **print, save, and load** the channel assignment template.

File name and path of the current channel assignment template file.

Operating mode of the program.

3.2 Installing the Software

System requirements

Software: One of the following Windows operating systems is required: **Windows 98, ME, NT, 2000, or XP (English and German versions supported)**. Other language versions may lead to software errors.

Hardware: Free RS232 port

Installing the software

Please check the system requirements before you install the software. Multi Channel Systems cannot guarantee that the software works properly if these requirements are not fulfilled.

Important: Please make sure that you have full control over your computer as an **administrator**. Otherwise, it is possible that the installed software does not work properly.

1. Double-click **Setup.exe** on the installation volume.
The installation assistant will show up and guide you through the installation procedure.
2. Follow the instructions of the installation assistant.

3.3 Setting Up and Connecting the MEA Switch



Warning: Do not mismatch the polarity of the external power supply. A wrong connection may lead to fatal damage of the device. Use the lowest possible input supply voltage. Do not exceed the maximum input supply voltage of 12 V. The higher the input supply voltage, the more heat is produced by the device.

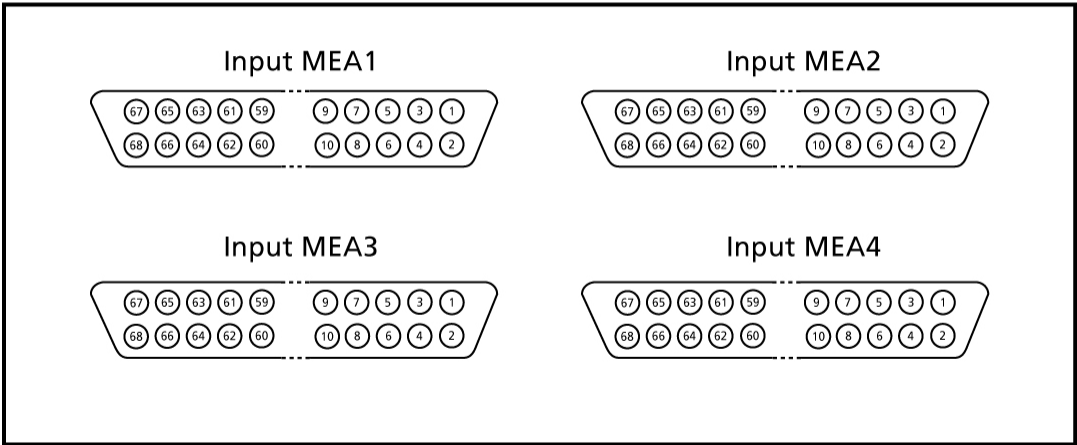
Important: If you use a complete MEA System, the MEA amplifier will usually be powered by the isolated power supply (IPS10W) that is integrated into the data acquisition computer. If you are using a MEA Switch, you will have to connect an **external power supply** to the MEA Switch for operating the amplifier(s). The power is then distributed along the MCS 68-Pin High Grade Cable. Please ask your local retailer for more information on the setup.

1. Connect the MEA Switch to a computer via the RS232 serial port with a standard null-modem cable (see illustration "MEAS4/2 rear panel").
2. Connect the MEA Switch output to the MC_Card in your computer via the provided 68 pin MCS Standard cable (see illustration "MEAS4/2 rear panel").
3. Connect the 2 (4) MEA1060 amplifiers to the MEA Switch via the provided 68 pin MCS Standard cables (see illustration "MEAS4/2 front panel"). Make sure that both cables are oriented to opposite sites to avoid a mechanical interference of the connectors (see photograph).

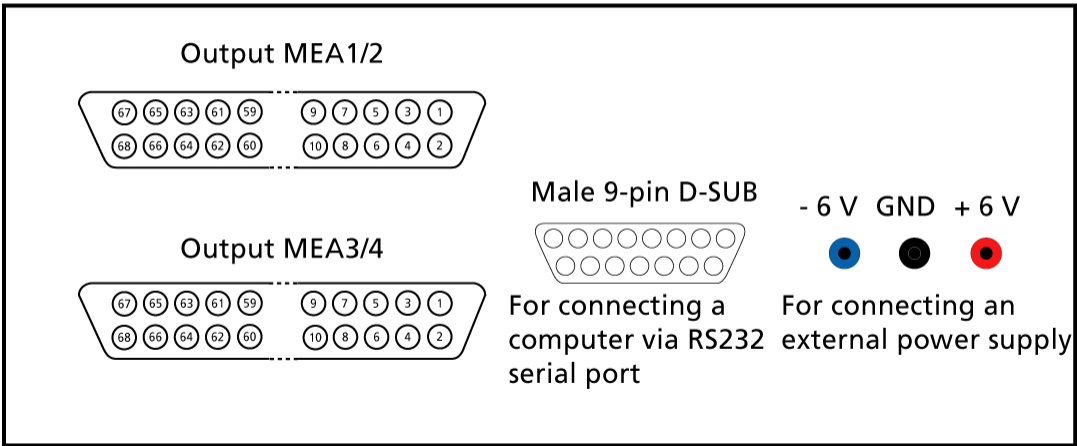


4. Connect the device to an external power supply.
5. (Optional) Eight additional inputs (standard BNC connectors) for the remaining eight free channels can be obtained on demand (see illustration "MEAS4/2 BNC Connectors").

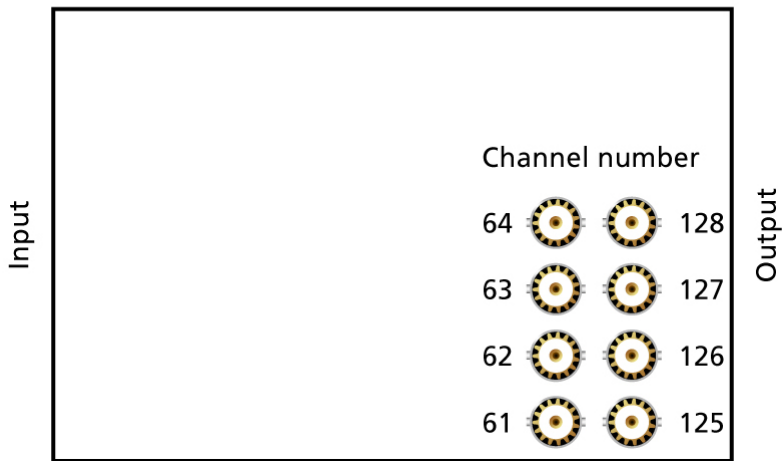
MEAS4to2 front panel



MEAS4to2 rear panel



MEAS4to2 BNC Connectors



The illustration "Experimental setup" shows a suggested setup for four MEA1060 amplifiers. You can define your custom setup as well.

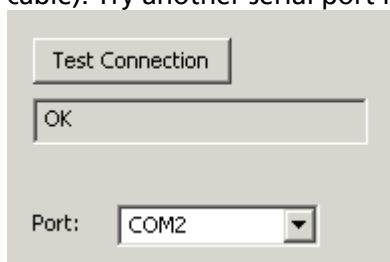
4 Operating the MEA Switch

4.1 Controlling the MEA Switch

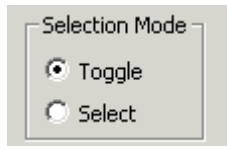
The 120 channels from two MEA1060 amplifiers are reduced to 60 channels. You can decide from which of the two amplifiers a channel should be picked. The channel selection is mutually exclusive, that means, channels with the same channel number, for example No. 21, cannot be picked from both amplifiers. If you use an MC_Card with 128 channels, you can use a MEAS4/2 for two pairs of MEA1060 amplifiers.

The Controlling the MEA Switch is computer-controlled via the serial port. You can easily make your selection with the MEA_Switch program. The other possibility recommended only for advanced users is to set up their own program. See "Firmware Description" in the Appendix for details.

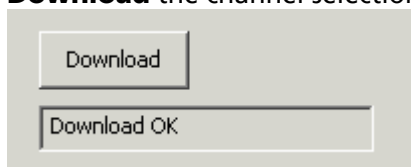
1. Double-click the **MEA_Switch.exe** file.
MEA_Switch starts.
2. Click **Test Connection** to test the connection to the MEA Switch hardware.
If the connection is fine, the message **OK** appears in the message box. If the message **Failed** appears, check all connections and make sure there is a power supply connected (power is usually supplied by the data acquisition computer connected via the 68-pin MCS High Grade cable). Try another serial port if the connection cannot be established.



3. If the connection has been established, select the operating mode (Toggle or Select).



4. Start data acquisition, for example with MC_Rack.
5. Choose the channels of interest from the amplifiers by clicking the corresponding buttons.
6. **Download** the channel selection to the MEA Switch. (**Apply** button in the **Select** mode)



7. Preview and Print the channel assignment for documentation.
8. Save the assignment as a template for later use if you like.

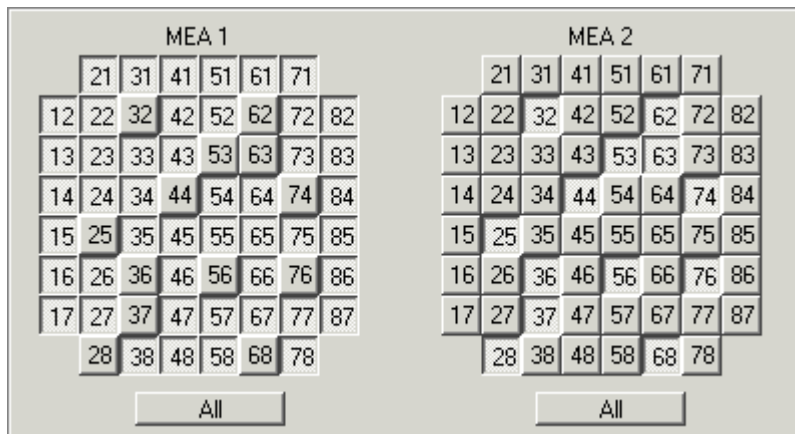
4.2 Toggling Channels

Each channel of the data stream is either assigned to the left or the right MEA. You cannot select the same channel from both MEAs.

The buttons represent single channels and have a toggle function. Click a button to select or deselect a channel. If you have a 128-channel MC_Card, you can configure the channel layout for two pairs of MEAs separately.

The **Select** mode allows you to pick all active channels from one MEA first, then switch to all 60 channels of the second MEA and select all active channels from this one, and then apply the selection with a single mouse click. See the chapter Selecting Channels for details.

1. Click a button to select a single channel or click **All** to select all channels.
A selected channel button appears pressed in. The corresponding channel on the other pair is deselected.
2. Click a selected channel again to deselect it.
The corresponding channel on the other pair is selected.
3. Click **Download** to apply the changes.



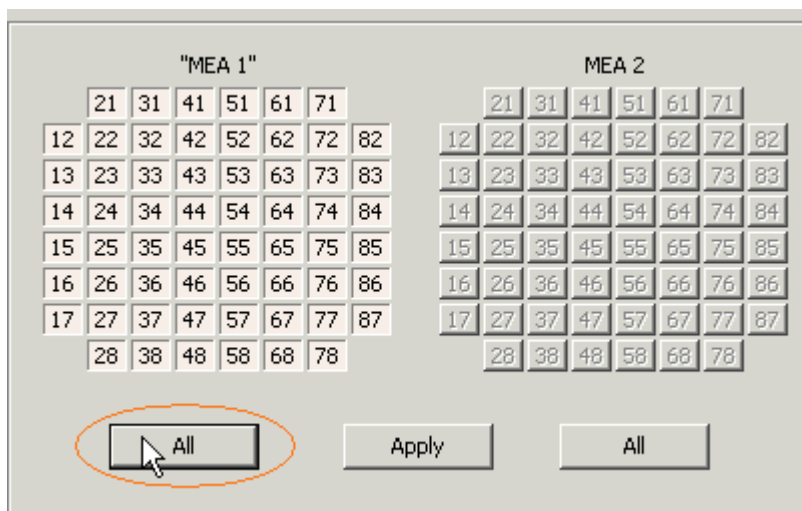
4.3 Selecting Channels

With this method, you mark the electrodes of both MEAs that are fine and that you want to record. All other electrodes are chosen from the default MEA1060 amplifier connected to port 1. Use MC_Rack to see the signals and decide which electrode you like to use for recording.

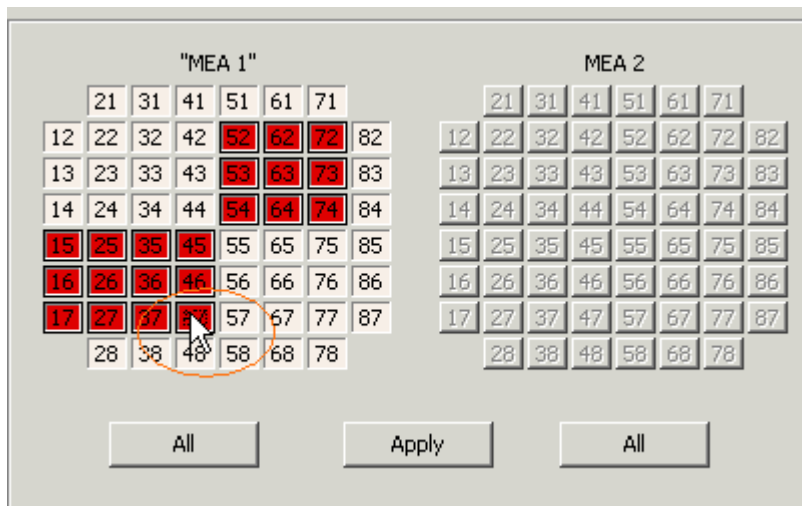
You can start to select channels from the **MEA 1** amplifier (as in the example), or with the **MEA 2** amplifier. The order of user actions is fixed in the **Select** mode: 1. selecting channels from one amplifier, 2. selecting channels from the other amplifier, 3. applying (downloading) the selection. If you like to change the selection later, restart the procedure from step 1.

The **Toggle** mode allows you to toggle each channel button for switching single channels from one amplifier to the other. See the chapter Toggling Channels for details.

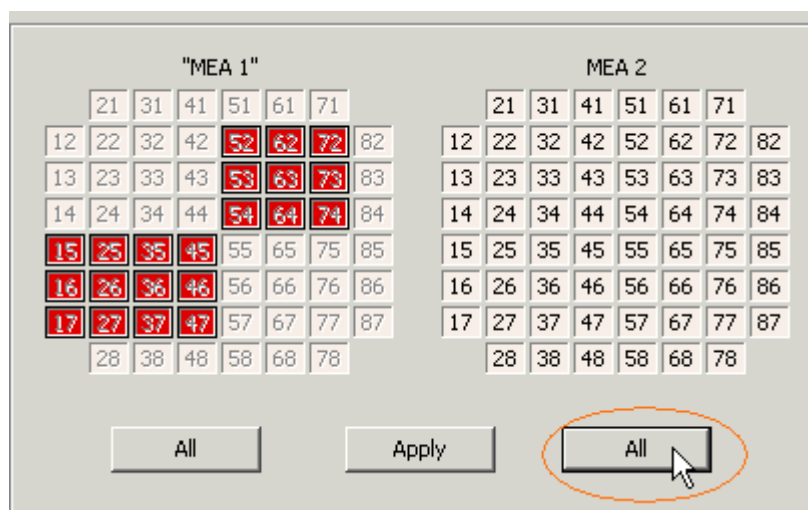
1. Switch to **MEA 1** by clicking **All** below the **MEA 1** button array. All channels from **MEA 1** are now transferred to the data acquisition system.



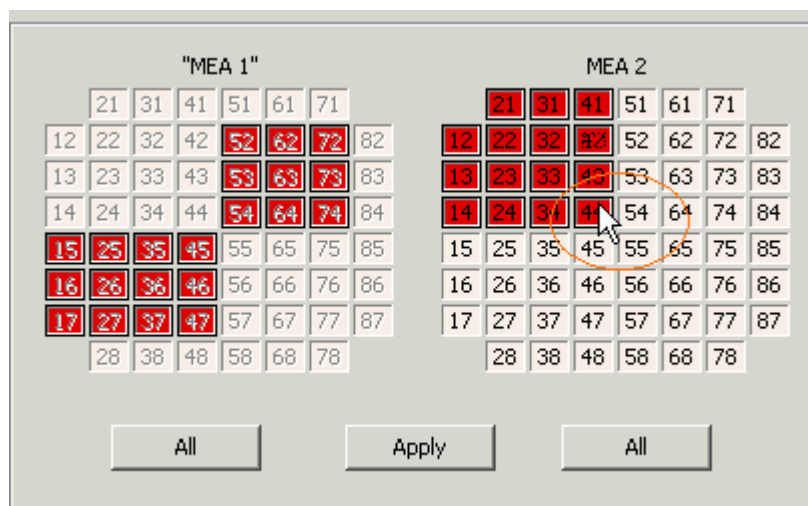
2. Click all electrodes that you are interested in. Selected electrodes are highlighted in red.



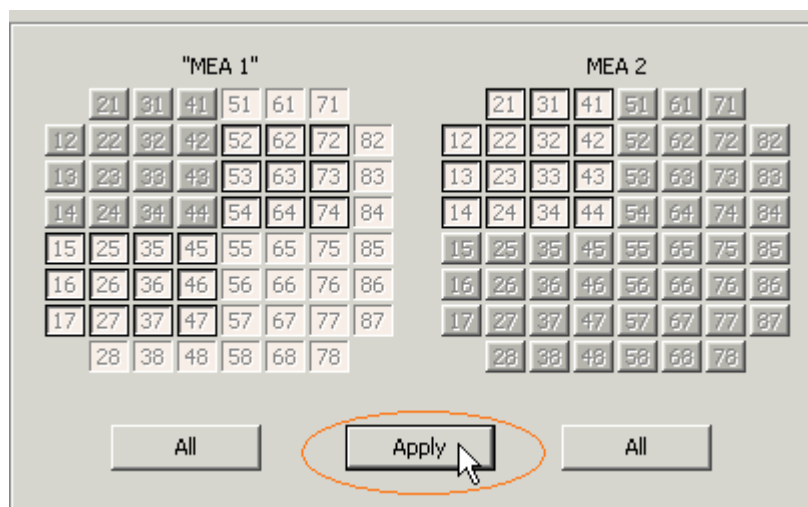
- Switch to **MEA 2** by clicking **All** below the **MEA 2** button array. All channels from **MEA 2** are now transferred to the data acquisition system.



- Choose all electrodes that you are interested in from MEA 2. Again, selected electrodes are highlighted in red.

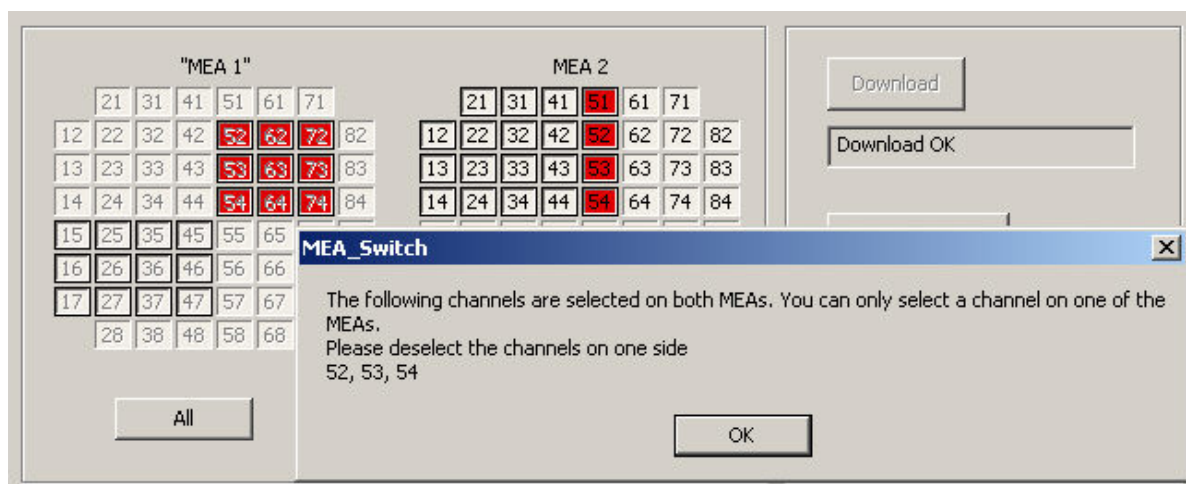


- Click **Apply** to record from the **selected** electrodes.



All selected channels from **both** MEAs are now transferred to the data acquisition system. Any channel that was not selected at all is recorded from **MEA 1**.

If you have chosen the same electrodes on both MEAs, a warning message will show up and ask you to unselect all electrodes that have been selected twice.



4.4 Setting Up or Loading a Template

If you have an experimental setup with similar channel assignments, it may be useful to save a channel selection for later use.

1. Click **Save**.
The **Save As** dialog box opens.
2. Browse your folders and enter a file name.
3. Click **Save**.
The channel selection is saved with the specified file name. The file extension is .cfg. The file name and path of the current template is displayed.

Loading a template

1. Click **Load**.
The **Open** dialog box opens.
2. Browse your folders and select an appropriate MEA_Switch Config file (*.cfg).
3. Click **Open**.
The channel selection of the template is applied. The file name and path of the current template is displayed.

4.5 Printing the Channel Assignment

In the data acquisition and analysis program MC_Rack, you cannot see from which amplifier the data is acquired. The data is treated as if it was acquired from one amplifier. Therefore, you should print the channel layout in MEA_Switch to document your experiment.

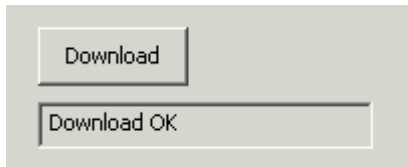
1. Click **Print**.
— OR —
Click **Preview** to see the printed page on screen, then click **Print**.
The standard **Print** dialog box appears.
2. Select a connected **Printer** and confirm with **OK**.
The active channel assignment is printed. Selected channels are printed in Gray.

4.6 Channel Assignment Download

When you have set up the desired channel assignment, you have to transfer the settings to the MEA Switch.

Note: You have to download the assignment each time you have switched on the switch. The default assignment that is active after the switch has been switched on is that the channels of the left MEA(s) (MEA 1 and 3) are selected.

1. Make sure the device has been switched on and the connection has been established. Click **Download**. (**Apply** button in the **Select** mode) Please note that the order of use actions is fixed in the **Select** mode, that is, the **Apply** button is only available if all necessary steps have been made (see Selecting Channels).
2. The successful transfer is confirmed by a message.



5 Appendix

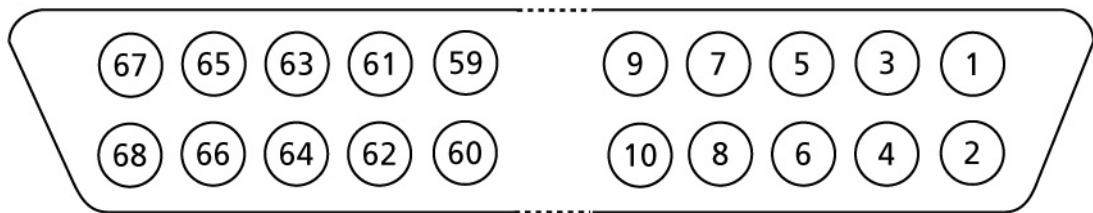
5.1 Technical Specifications

Operating temperature	10–40 °C
Storage temperature	0–50 °C
Dimensions (WxDxH)	220 mm x 235 mm x 52 mm
Weight	1050 g
Supply voltage	+/- 6 V (min +/- 5.7 V, max +/- 12 V)
Supply current	-2 mA to +38 mA
Number of input channels	2 x 64 (MEAS2/1), 2 x 64 + 2 x 64 (MEAS4/2)
Input voltage	5 V
Input impedance	33 k Ω
Number of output channels	64 (MEAS2/1), 2 x 64 (MEAS4/2)
Output voltage	5 V
Output impedance	300 Ω paralleled by 1 nF (low pass)
Interface	RS232 serial port, 57600 baud 8 N1 no handshake
MEA_Switch program	
Operating system	Windows 98, ME, NT, 2000, or XP; English and German versions supported
Two versions are available, MEAS2/1 and MEAS4/2.	

5.2 Pin Layout

Electrode/analog input

68-Pin MCS Standard connector

*128 ch. expansion*

Pin 1:	GNDP (power ground)	GNDP (power ground)
Pin 2:	GNDS (signal ground)	GNDS (signal ground)
Pin 3-66:	Channels 1-64	Channels 65-128
Pin 67:	Positive voltage supply	Positive voltage supply
Pin 68:	Negative voltage supply	Negative voltage supply

Note: The analog channel 64 is available **only** if the digital input channel is **not** selected in the **Channel Layout** dialog box of the MC_Rack program.

Please note that channels 61 to 64 and 125 to 128 are **not** used for the **MEA** System. Channels 61 to 63 can be used as additional analog input channels A1 to A3 via the additional BNC connectors.

5.3 Firmware Description

You can control the MEAS2/1 and MEAS4/2 with a Terminal program. There are several shareware programs available on the internet. You can use the following information to write your own program for controlling the MEAS2/1 and MEAS4/2 as well.

Serial communication

- Serial port parameters: 57600 Baud 8N1 no handshake
- All commands are single characters, some followed by one or more hexadecimal numbers.
- Commands must be terminated by either '\n' or '\r'. Hexadecimal numbers must be two bytes.
- Response of the device is a single character.

Controlling the MEAS2/1 and MEAS4/2

The internal switches are divided in groups of 8. The 8-bit code to program these 8 switches (for example, 01100101) has to be reversed (e.g. 10100110) first, and then translated into hexadecimal 2-bit code. The order of the switches is from channel 1 to 64 (MEAS2/1). That means, group 1 is defined from 1 to 8, group 2 from 9 to 16, and so on. For MEAS4/2, channels 65 to 128 come first, and then channels 1 to 64. That means, group 1 is defined from 65 to 72, group 2 from 73 to 80, and so on.

The total group number has to be specified in hexadecimal 2-bit code as well, that is 08 for the 8x8 channels of MEAS2/1 and 10 for the 16x8 channels of MEAS4/2.

Command	Description	Response
v	get version	a,b,...
t	test connection	t
d<total group/byte number><switch list>	set channel selection	0: ok not 0: error

Example:

You type...	The response is...	Explanation
v	a	The current version is "a".
t	t	Connection established.
d08ffffffffffffffff	0	The syntax of the command is ok. All bits of the 8 groups have been set to 1.

5.4 Contact Information

Local retailer

Please see the list of official MCS distributors on the MCS web site.

User forum

The **Multi Channel Systems User Forum** provides the opportunity for you to exchange your experience or thoughts with other users worldwide.

Mailing list

If you are subscribed to the General Electrophysiology Mailing List, you will be automatically informed about new software releases, upcoming events, and other news on the product line. You can subscribe to the list on the MCS web site.

www.multichannelsystems.com

5.5 Ordering Information

This chapter shows you a selection of MCS products. For information on the whole product range, pricing and ordering information, please contact your local retailer.

MEA Switch

Product	Product Number	Description
MEA Switch for 4 amplifiers	MEAS4/2	The MEA Switch allows you to acquire data from 60 single channels from two MEA1060 amplifiers. If you have a 128-channel MC_Card (MEA 120 System), you can even pick 128 channels in total from two MEA pairs with the MEA Switch for four amplifiers MEAS4/2. The selected channels are combined to one Electrode Raw Data stream that is delivered to MC_Card by a 68 pin MCS High Grade Cable.
MEA Switch for 2 amplifiers	MEAS2/1	

MEA amplifiers

Product	Product Number	Description
MEA amplifier for inverted microscopes	MEA1060-Inv	Probe interface and 60 channel pre- and filter amplifier with custom gain and bandwidth
MEA amplifier for upright microscopes	MEA1060-Up	
MEA amplifier with blanking circuit for inverted microscopes	MEA1060-Inv-BC	Probe interface and 60 channel pre- and filter amplifier with custom gain and bandwidth. The blanking circuit prevents the amplifier from getting saturated and thus prevents stimulus artifacts.
MEA amplifier with blanking circuit for upright microscopes	MEA1060-Up-BC	

MEA Systems

Product	Product Number	Description
MEA recording system for inverted microscopes, 60 electrode channels	MEA60-Inv-System	Complete with 5 MEAs, data acquisition computer with MC_Card, MEA1060-Inv amplifier, TC01, power supply, and accessories
MEA recording system for inverted microscopes, 60 electrode channels, 2 MEA amplifiers	MEA60-Inv-2-System	Complete with 5 MEAs, data acquisition computer with MC_Card, 2 x MEA1060-Inv amplifier, MEAS2/1, TC02, power supply, and accessories
MEA recording system for upright microscopes, 60 electrode channels	MEA60-Up-System	Complete with 5 MEAs, data acquisition computer with MC_Card, MEA1060-Up amplifier, TC01, power supply, and accessories
MEA recording system for upright microscopes, 60 electrode channels	MEA60-Up-2-System	Complete with 5 MEAs, data acquisition computer with MC_Card, 2 x MEA1060-Up amplifier, MEAS2/1, TC02, power supply, and accessories
MEA recording system for inverted microscopes with advanced perfusion, 60 electrode channels	MEA60-Inv-System-E	Complete with 5 MEAs, data acquisition computer with MC_Card, MEA1060-Inv amplifier, TC02, PH01, power supply, and accessories
MEA recording system for inverted microscopes with advanced perfusion, 60 electrode channels	MEA60-Inv-2-System-E	Complete with 5 MEAs, data acquisition computer with MC_Card, 2 x MEA1060-Inv amplifier, MEAS2/1, 2 x TC02, 2 x PH01, power supply, and accessories
MEA recording system for upright microscopes with advanced perfusion, 60 electrode channels	MEA60-Up-System-E	Complete with 5 MEAs, data acquisition computer with MC_Card, MEA1060-Up amplifier, TC02, PH01, power supply, and accessories
MEA recording system for upright microscopes with advanced perfusion, 60 electrode channels	MEA60-Up-2-System-E	Complete with 5 MEAs, data acquisition computer with MC_Card, 2 x MEA1060-Up amplifier, 2 x TC02, 2 x PH01, power supply, and accessories
MEA recording system for inverted microscopes, 120 electrode channels	MEA120-Inv-System	Complete with 5 MEAs, data acquisition computer with MC_Card, MEA1060-Inv amplifier, TC02, power supply, and accessories
MEA recording system for inverted microscopes, 120 electrode channels	MEA120-Inv-4-System	Complete with 5 MEAs, data acquisition computer with MC_Card, 4 x MEA1060-Inv amplifier, MEAS4/2, 2 x TC02, power supply, and accessories
MEA recording system for upright microscopes, 120 electrode channels	MEA120-Up-System	Complete with 5 MEAs, data acquisition computer with MC_Card, MEA1060-Up amplifier, TC02, power supply, and accessories
MEA recording system for upright microscopes, 120 electrode channels	MEA120-Up-4-System	Complete with 5 MEAs, data acquisition computer with MC_Card, 4 x MEA1060-Up amplifier, MEAS4/2, 2 x TC02, power supply, and accessories

Accessories

Product	Product Number	Description
Channel Grounding Unit	GND64	Placed between the amplifier and MC_Card; grounds unused channels by sliding switches for preventing noise
MEA Signal Divider	SD-MEA	Placed between the amplifier and MC_Card; permits to select any channel, does not interfere with the data acquisition

Spare Parts

Product	Product Number	Description
0.5 m 68-pin MCS High Grade Cable	C68x0.5M	For MEA or ME Systems
1 m 68-pin MCS High Grade Cable	C68x1M	
3 m 68-pin MCS High Grade Cable	C68x3M	

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Baud rate 16

Buttons
channel buttons 10, 11

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